5. "On the Nitrogenous Principles of Vegetables as the sources of artificial Alkaloids." By John Stenhouse, F.R.S.

After observing that there are few departments in organic chemistry which during the last six or seven years have attracted more of the attention of experimenters than the artificial formation of the alkaloids, and attributing this fact to the interesting nature of this class of bodies both as regards their well-defined chemical properties and the important medical virtues which many of them possess, the author proceeds to state, that although attempts to form the natural alkaloids, such as quinine, cinchonine, &c., by artificial means have hitherto been unsuccessful, yet chemists have been enabled by various processes to procure artificially a considerable number of true alkaloids very analogous to those which occur in nature. The various methods by which this has been effected, such as by acting on essential oils with ammonia, by the destructive distillation of coal and animal substances, &c., are then enumerated and described.

It is also remarked as somewhat singular, that while so many other sources have been examined, no attempt should have been made to procure alkaloids from vegetable albumen, fibrine, caseine, &c., which are so rich in nitrogen, and which occur in such abundance in many plants. What renders the neglect of these substances the more remarkable, is the consideration that coal has been one of the most productive sources of the alkaloids, yielding them, as it does, four other bases besides ammonia. Now as coal is universally admitted to be of vegetable origin, and to consist of the remains of a variety of extinct vegetables, the nitrogenous principles of which must be regarded as the sources of the bases which it yields, it seemed to the author not unreasonable to expect, that, by acting on the nitrogenous principles of recent vegetables, the same organic bases as those obtained from coal, or at any rate a series of analogous bases, would be obtained in still greater abundance; and it subsequently appeared that this latter expectation was not altogether without foundation.

From the difficulty of procuring vegetable albumen, fibrine, &c. in a state of even tolerable purity, those portions of plants (usually their seeds) were selected which contain those principles in the greatest abundance.

In the first instance, a quantity of *Phaseolus communis*, or common horse-bean, was destructively distilled in a cast-iron cylinder, and the products collected by means of a large condensing Liebig's apparatus. These products closely resembled those obtained from the distillation of bones and other animal matters, comprising among other substances acetic acid, empyreumatic oils, tar, a great deal of ammonia and several organic alkaloids. The crude product was supersaturated with muriatic acid, and the clear liquid decanted after the tar had subsided. The acid liquor was next passed through a cloth filter, which removed the greater portion of the resinous matter. The clear liquid was then poured into a capacious still, and supersaturated with carbonate of soda. When the liquid began to boil, much ammonia was disengaged, and a quantity of oily bases collected in the receiver. Their amount increased as the distillation proceeded. These bases were separated from the ammoniacal liquid

by means of a pipette, and were purified by suitable processes which it is unnecessary to particularize. These bases, though they were found to vary very considerably in their boiling-points and some of their properties, were very similar in other respects. They were transparent colourless oils, which were all of them lighter than water, and refracted light strongly. Their taste was hot, resembling that of oil of peppermint. They all exhibited strong alkaline reactions, and neutralized the acids perfectly, forming crystallizable salts. The most curious circumstance respecting them was, that they wereapparently quite different from the series of bases obtained from either bones or coal, and contained no aniline.

One of these bases was isolated and subjected to analysis. It boiled between 150° and 155° C. Its formula was found to be C_{10} H_6 N, which differs only by two equivalents of hydrogen from nicotine. The only obstacle which has hitherto prevented the separation and examination of each of these bases individually, has arisen from the difficulty of procuring them in sufficient quantity. Not that beans when distilled yield bases in so much smaller quantities than bones and other animal substances; but as both bones and coal are distilled on the largest scale for commercial purposes, their crude oils may be easily procured in any quantity, and from these their respective series of bases may be readily prepared. In regard to the bases from beans and other seeds, the case is quite different; as the scientific chemist is compelled to distil these substances on purpose, an operation which cannot be conveniently conducted in a laboratory, since it requires an apparatus so large as to be almost upon a manufacturing scale.

Oil-cake.—As the *Phaseolus communis* was regarded as the type of the Leguminosæ, oil-cake, or the expressed seeds of *Linum usitatissimum*, was selected from that numerous class of plants in which the starch of the Gramineæ is replaced by oil. The products of its distillation were very similar to those from beans, containing however more ammonia and a somewhat smaller proportion of oily bases, which, though similar, appeared to differ from those of the preceding series. They were also equally devoid of aniline.

Wheat, *Triticum hybernum*, and subsequently peat from the neighbourhood of Glasgow, were also destructively distilled. Both of these substances, in addition to ammonia, yielded a series of oily bases, which also contained no aniline.

Distillation of wood.—The author proceeds to state, that through the kindness of an extensive pyroligneous acid manufacturer he was enabled to examine considerable quantities of the crude acid liquor obtained from the destructive distillation of beech, oak, and other hard woods. The stems and larger branches of trees are alone employed for this purpose. He found to his surprise that this acid liquor contained scarcely a trace of ammonia or of any other organic base, showing that the woody portions of the limbs and stems of trees are nearly devoid of nitrogenous matter, in which respect they differ extremely from peat, which in general contains two per cent. of nitrogen; and he considers this circumstance as perhaps calculated

to throw some light upon the origin of the coal-beds, which some geologists believe to have been formed from the submersion of forests and the floating of uprooted timber into estuaries and lakes, while others contend that they have been produced by the submersion of beds of peat. Irrespective therefore of other considerations, the author urges in favour of the latter opinion, that wood is not capable of furnishing the amount of nitrogen we find existing in coal, while peat contains rather more than double the quantity required. The expectation of procuring aniline, picoline, &c., the coal series of bases, from the distillation of peat, was disappointed; a result only to be accounted for on the hypothesis, that the different genera of plants, when destructively distilled, yield different series of organic bases.

From the facts which have previously been stated, the author considers himself warranted in concluding, that when ammonia is produced by the destructive distillation of either animal or vegetable substances, it is always accompanied with the formation of organic bases. Now as ammonia is known to be procurable from these substances by other methods than destructive distillation, it seemed highly probable that on these occasions organic bases would also be produced. Beans, oil-cake and flesh, were therefore successively boiled in a distilling apparatus with strong alkaline lyes. In every instance, in addition to ammonia, a series of organic bases was also produced. Similar results were also obtained when the above-mentioned substances were digested in strong sulphuric acid, the acid solution supersaturated with an alkali and subjected to distillation. The ammoniacal liquor which passed into the receiver was found invariably to contain organic bases.

Bases by putrefaction.—As putrefaction is almost the only other means by which ammonia is readily procurable in quantity from vegetable and animal substances, the effects of this process were also examined in the first instance in the case of guano. An aqueous solution of Peruvian guano was saturated with carbonate of soda and distilled. In addition to much ammonia, a quantity of basic oils was also obtained. Subsequent to this experiment, the effects of putrefaction on a quantity of horse-flesh were also examined, when a considerable amount of oily bases was found to have been generated.

From the facts which have now been enumerated, the author concludes "*that whenever ammonia is generated in large quantity from complex animal or vegetable substances, it is invariably accompanied by the formation of a larger or a smaller amount of volatile organic bases.*" If therefore researches similar to the present are actively prosecuted, and if the seeds and leaves of the various genera of plants are subjected to these or analogous processes, it seems not unreasonable to expect that the number of the organic alkaloids will ere long be considerably increased.

6. "On the Development and Varieties of the great anterior veins in Man and Mammalia." By John Marshall, Esq. Communicated by Professor Sharpey, F.R.S.

The object of this paper is to state the result of observations on